

SFCTA Contract Number 06/07-29

Caltrans EA Number 04-163701

SOUTH ACCESS TO THE GOLDEN GATE BRIDGE

DOYLE DRIVE

DOYLE DRIVE REPLACEMENT PROJECT

High Viaduct

Hydraulics Report

February 2009

Revised July 2009

Prepared By:

Arup PB Joint Venture

This High Viaduct Hydraulics Report has been prepared under the direction of the following Registered Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which the recommendations, conclusions and decisions are based.

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BORI TOURAY
REGISTERED CIVIL ENGINEER

July 29, 2009
DATE



California Department of
Transportation District 4

**Doyle Drive
Replacement Project**

High Viaduct
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This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party

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1 Introduction

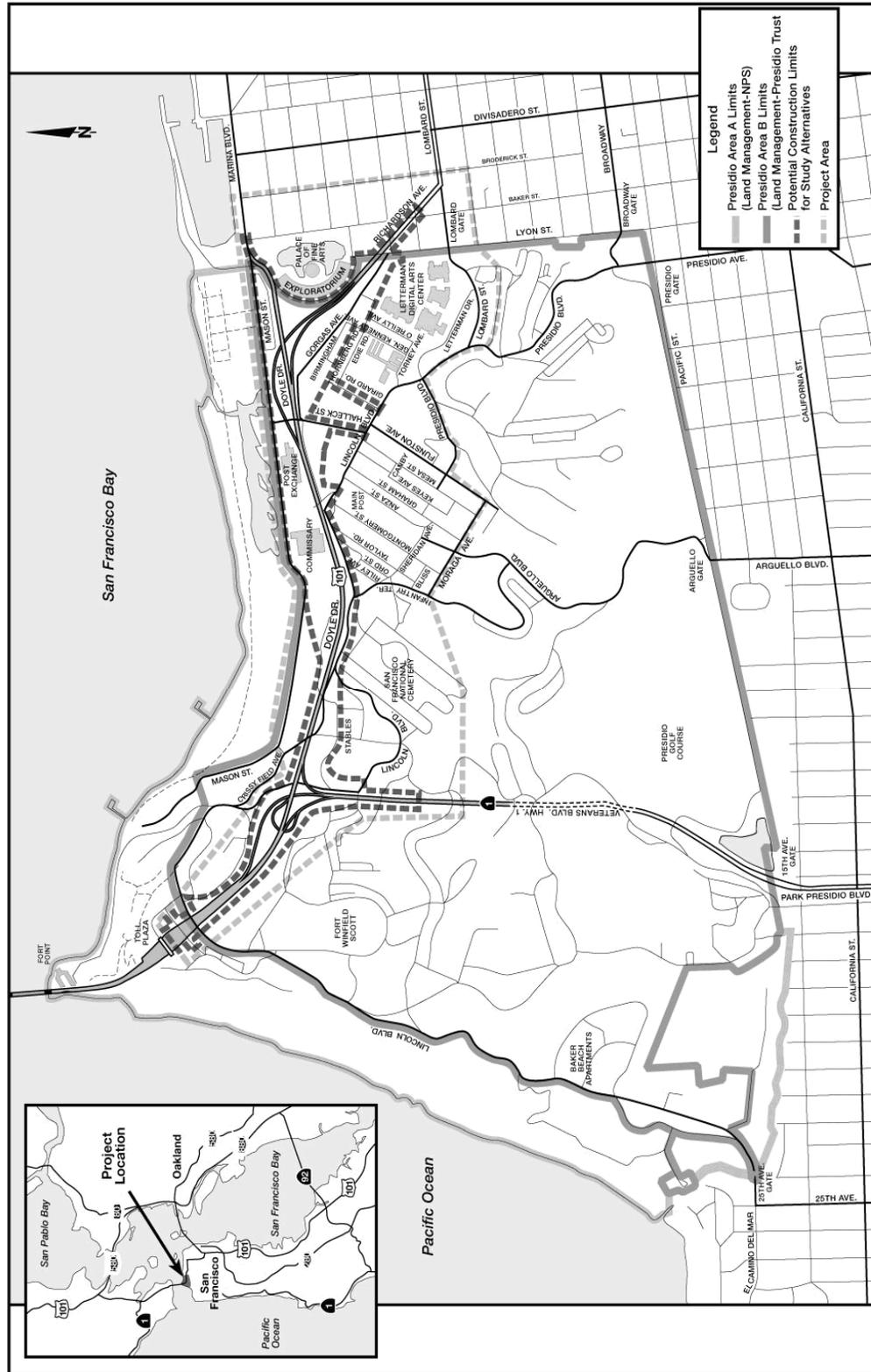
1.1 Purpose

The Caltrans “Office of Special Funded Projects (OSFP) Information and Procedures Guide” requires that a separate hydraulic report be prepared for each structure in, over or adjacent to streams and waterways which may affect the design or construction of structures (Reference 1). This report determines the water surface elevations, velocities and preliminary scour depths for the proposed Doyle Drive High Viaduct. The High Viaduct spans across the outlet of the Fort Scott watershed as it discharges into the San Francisco Bay. Under existing conditions, there is no natural stream as the channel has been covered over and the runoff is conveyed in storm drains and as surface runoff. The amount of the 100-year surface runoff is considerable and could affect any bridge piers under the viaduct. The scour depths in this report are preliminary and is not to be used for because the geotechnical information required for estimation of scour depths was not available at the time of writing of this report. The expenditure authorization is EA 163701.

1.2 Background

Doyle Drive Replacement Project is 1.5 linear miles and is the southern approach of Route 101 to the Golden Gate Bridge in Caltrans District 4, San Francisco County (Figure 1). Doyle Drive is approaching the end of its useful life after over 70 years of operation. In the short-term, regular maintenance, seismic retrofit, and rehabilitation activities are keeping the structure safe. In the long-term, permanent improvements are needed to bring Doyle Drive up to current design and safety standards. The San Francisco Board of Supervisors recommended that Caltrans develop a scheme that would improve safety and not increase the number of vehicles using Doyle Drive.

Figure 1: Location Map



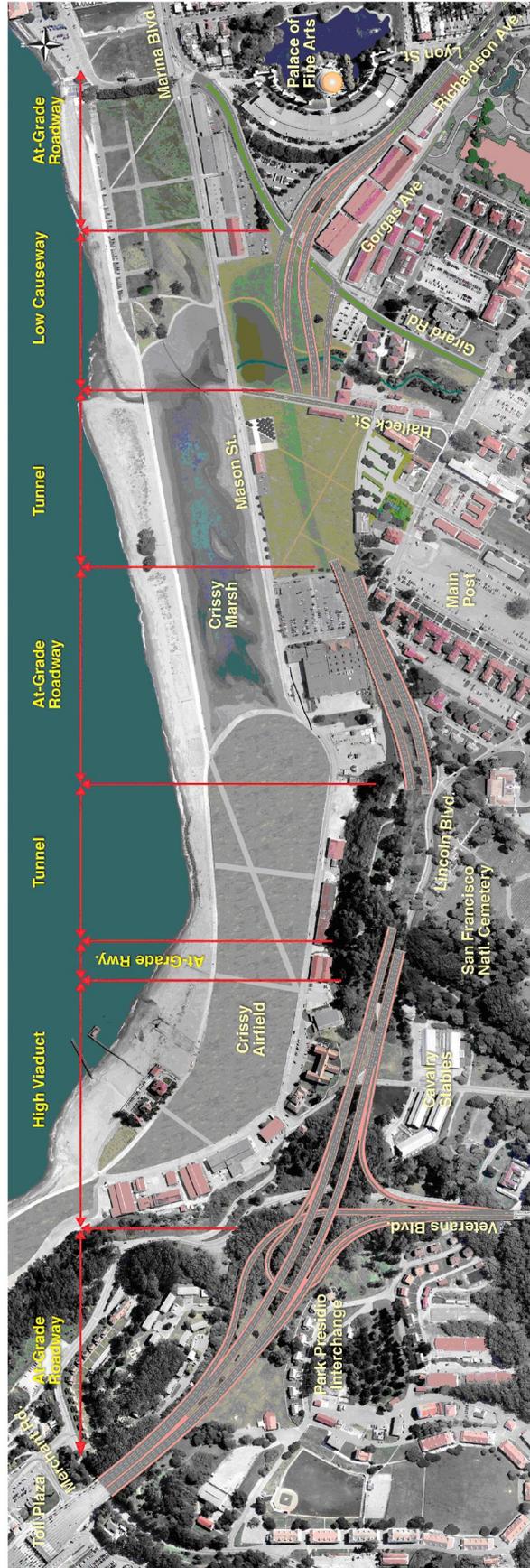
project area.ai

2 Preferred Alternative

The preferred alternative will replace the existing roadway with a new six-lane facility and a southbound auxiliary lane, between the Park Presidio Interchange and the new Presidio access at Girard Road (Figure 2). The new facility will consist of two 11-foot lanes and one 12-foot outside lane in each direction with 10-foot outside shoulders and 4-foot inside shoulders. In addition, an 11-foot auxiliary lane runs along southbound Doyle Drive from the Park Presidio Interchange to the Girard Road exit ramp. The total roadway width will be 105 feet and the overall facility width including the median will vary from 122 to 146 feet. The width of the proposed landscaped median varies from 16 feet to 41 feet. To minimize impacts to the area, the footprint of the new facility will include a large portion of the existing facility's footprint east of the Park Presidio Interchange. The existing elevated Doyle Drive is supported by bents that are located approximately every 31 feet along the alignment. The lateral spacing of abutments will increase to approximately 100 feet.

The preferred alternative includes a 1362-foot high viaduct at Post-Mile 9.02 to 9.26, between the Park Presidio Interchange and the San Francisco National Cemetery. The height of the high-viaduct would vary from 66 to 115 feet above the ground surface.

Figure 2: Preferred Alternative



3 Hydrologic Analysis

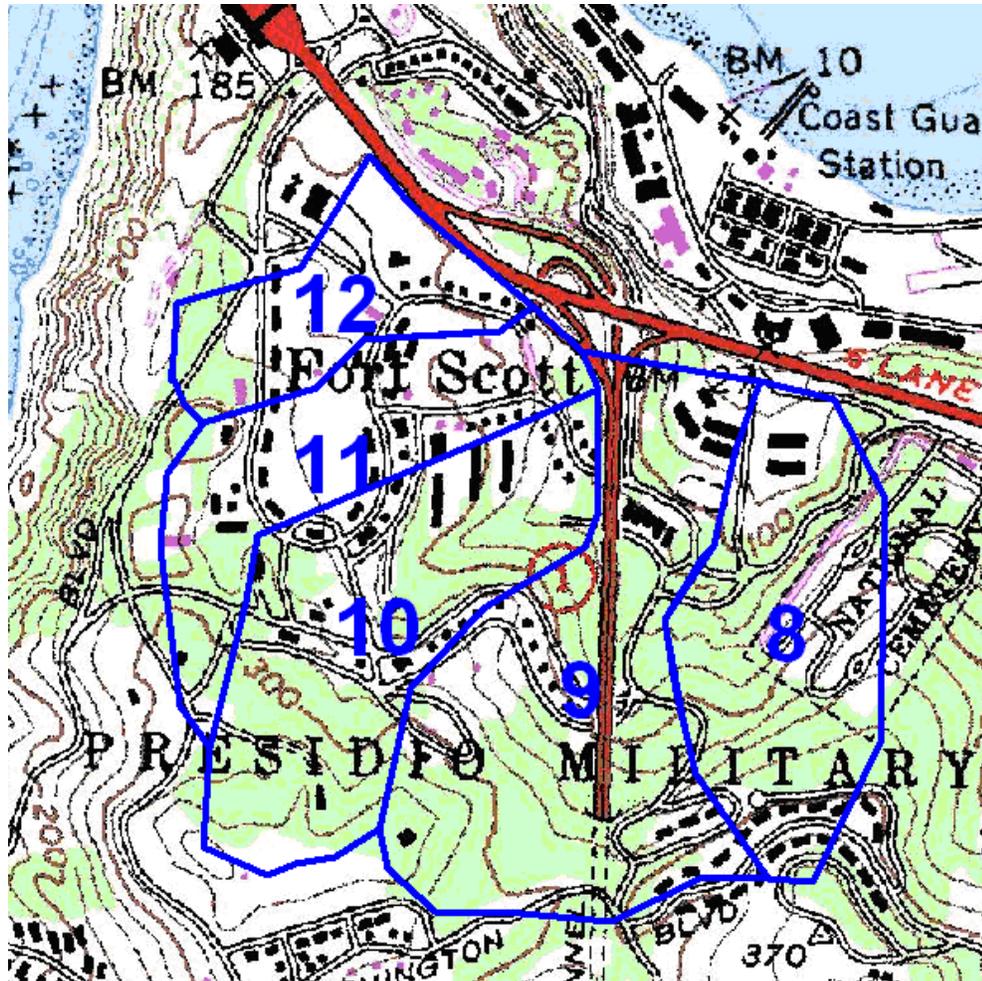
3.1 Approach

The US Army Corps of Engineers' HEC-HMS computer program was used to compute the 2-, 10-, 25-, 50-, 100- and 500-year watershed runoff. The program is designed to simulate the precipitation-runoff processes of dendritic watershed systems. It is designed to be applicable in a wide range of geographic areas for solving the widest possible range of problems. HEC-HMS is applicable for the analysis at the Doyle Drive site.

3.2 Watershed Description

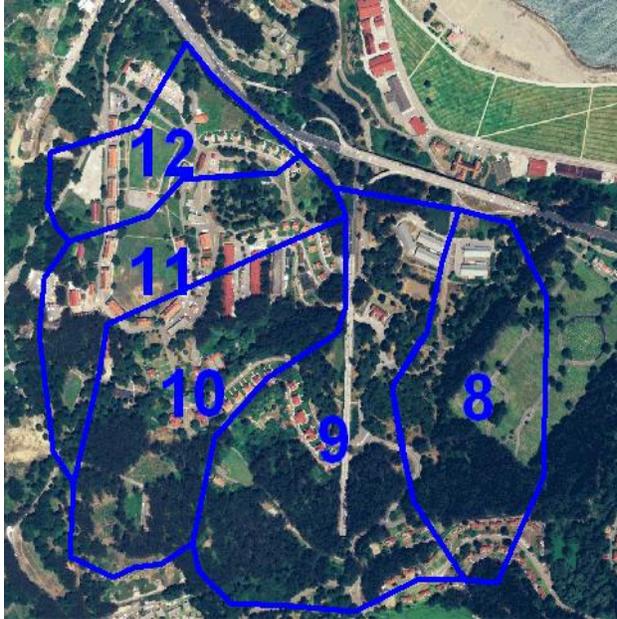
The watershed draining to the High Viaduct consists of approximately 229 acres of various land uses, including open space, residential, commercial, industrial, and institutional. The watershed was delineated on USGS quadrangle map (Figure 3).

Figure 3: High Viaduct Watershed Boundaries



There are no open channel creeks or streams that cross the current Doyle Drive alignment. The majority of the drainage in the urban areas occurs through the Presidio storm drain system in an underground pipe network and in open channels parallel to roads. The watershed is covered by approximately 44 acres of impervious surfaces (i.e., roads, parking lots, and buildings) (Figure 4).

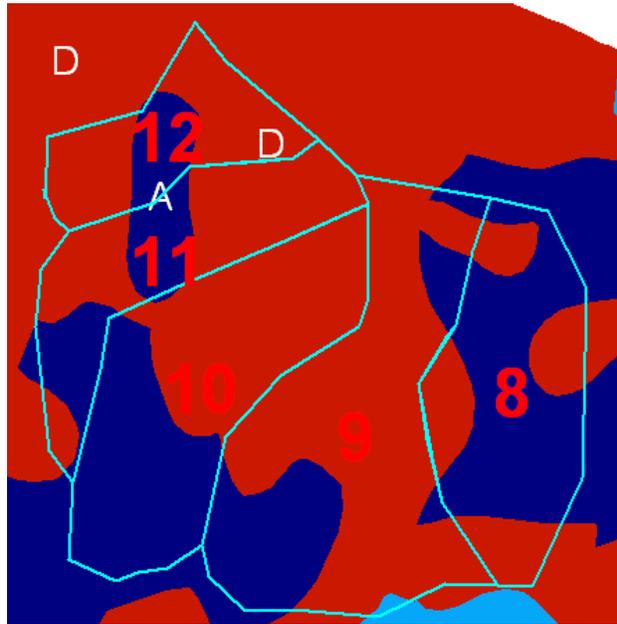
Figure 4: Land Use



The rain gage for San Francisco City, Gage No. E70 7772 00, with over 116 years of data was used for analyzing the runoff from the watershed. The rainfall data was obtained from the California Department of Water Resources website (Appendix A). The Natural Resource Conservation Service Hydrologic Soil Groups and curve number procedure were used to estimate rainfall infiltration. The watershed is covered by Hydrologic Soil Groups A, B and D (Figure 5). Soils are classified by the Natural Resource Conservation Service into four Hydrologic Soil Groups based on the soil's runoff potential. The four Hydrologic Soil Groups are A, B, C and D. A's generally have the smallest runoff potential and D's the greatest.

Group A is sand, loamy sand or sandy loam types of soils. It has low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sands or gravels and have a high rate of water transmission.

Group B is silt loam or loam. It has a moderate infiltration rate when thoroughly wetted and consists chiefly or moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Figure 5: Hydrologic Soil Groups

Group C soils are sandy clay loam. They have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine structure.

Group D soils are clay loam, silty clay loam, sandy clay, silty clay or clay. This HSG has the highest runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface and shallow soils over nearly impervious material.

Table 1 shows the Sub-basin areas, impervious cover and Hydrologic Soil Group areas.

Table 1: Sub-basin areas, impervious cover and Hydrologic Soil Group

SHED	HSG A (AC)	HSG B (AC)	HSG D (AC)	IMP %	Total AREA (AC)
8	28.5	0.0	16.2	11%	44.7
9	19.6	0.4	50.5	16%	70.4
10	25.1	0.0	29.1	18%	54.2
11	11.9	0.0	23.6	27%	35.5
12	5.4	0.0	18.6	37%	23.9
TOTAL	90.4	0.4	137.9	19.0	228.7

Excess runoff was transformed into flow hydrographs using the kinematic wave method. The kinematic wave method is designed principally for representing urban areas, although it can be used for undeveloped regions as well. It is a conceptual model that includes one or two representative planes. The same meteorologic boundary conditions are applied to each plane. Table 2 shows the kinematic wave parameters used for the watershed.

Table 2: Kinematic Wave Parameters for Pervious Areas

OVERLAND				
SHED	LENGTH (FT)	US EL	DS EL	SLOPE
8	300	360	306	0.1797
9	300	360	329	0.1027
10	300	360	340	0.0661
11	300	325	308	0.0558
12	300	310	279	0.1022
COLLECTOR CHANNEL				
SHED	LENGTH (FT)	US EL	DS EL	SLOPE
8	841	306	155	0.1797
9	430	329	285	0.1027
10	834	340	285	0.0661
11	506	308	280	0.0558
12	434	279	235	0.1022
MAIN CHANNEL				
SHED	LENGTH (FT)	US EL	DS EL	SLOPE
8	1513	155	30	0.0826
9	2569	285	30	0.0993
10	1823	285	120	0.0905
11	2488	280	130	0.0603
12	1060	235	165	0.0660

The storm drains do not have the capacity to convey even the 10-year event according to Dames and Moore who performed a detailed analysis of the system in 1994 (Reference 2). Most of the flow in the 10-year event and events higher than the 10-year will be surface runoff instead of storm drain flow. The storm drain system has therefore been neglected in this study.

3.3 Results

Table 3 shows the existing 100-year flows at Doyle Drive. There are no stream gages in the watershed and the model could not be calibrated to accurately represent the area. To provide a sense of how reasonable the results may be, the watershed was analyzed using National Flood Frequency (NFF) Program regression equations for the central coast region of California (Appendix A). The National Flood Frequency (NFF) Program provides equations for estimating the magnitude and recurrence intervals for floods in urbanized areas throughout the conterminous United States and Hawaii. These equations have been

areas throughout the conterminous United States and Hawaii. These equations have been thoroughly tested and proven to give reasonable estimates for floods having recurrence intervals between 2 and 500 years. The comparison indicates that the HEC-HMS 100-year flow is approximately 18% higher than the regression equations.

The results are greater than those presented in the Dames and Moore report entitled "Presidio of San Francisco Storm Water Management Plan" October 1994. The difference is due to the short duration storm used by Dames and Moore.

Table 3: Flows at High Viaduct

RECURRENCE INTERVAL (YEARS)	PEAK FLOW (CFS)		% DIFFERENCE
	HEC-HMS	REGRESSION	
2	171	139	18.7
10	321	284	11.5
25	399	335	16.0
50	464	388	16.4
100	530	433	18.3
500	685	501	26.9

4 Hydraulic Analysis

4.1 Approach

The project site is not located in a Federal Emergency Management Agency's (FEMA) flood hazard zone. The US Army Corps of Engineers HEC-RAS computer program was used to compute the water surface elevations and velocities for the watershed runoff draining to the High Viaduct. HEC-RAS is a computer program that models the hydraulics of water flow through natural rivers and other channels. The program was developed by the US Army Corps of Engineers Hydrologic Engineering Center. It includes numerous data entry capabilities, hydraulic analysis components, data storage and management capabilities, and graphing and reporting capabilities. HEC-RAS is capable of both steady and unsteady flow analysis. HEC-RAS is equipped to model a network of channels, a dendritic system or a single river reach.

4.2 Water Surface Elevations and Velocities

Water surface elevations and velocities were computed in HEC-RAS for the watershed runoff (Table 4). The anticipated 100-year tsunami water surface of 11.2 feet NAVD 88 in the vicinity of the High Viaduct is lower than the natural ground at the High Viaduct and will therefore not affect the water surface elevations.

Table 4: Water Surface Elevations and Velocities at High Viaduct

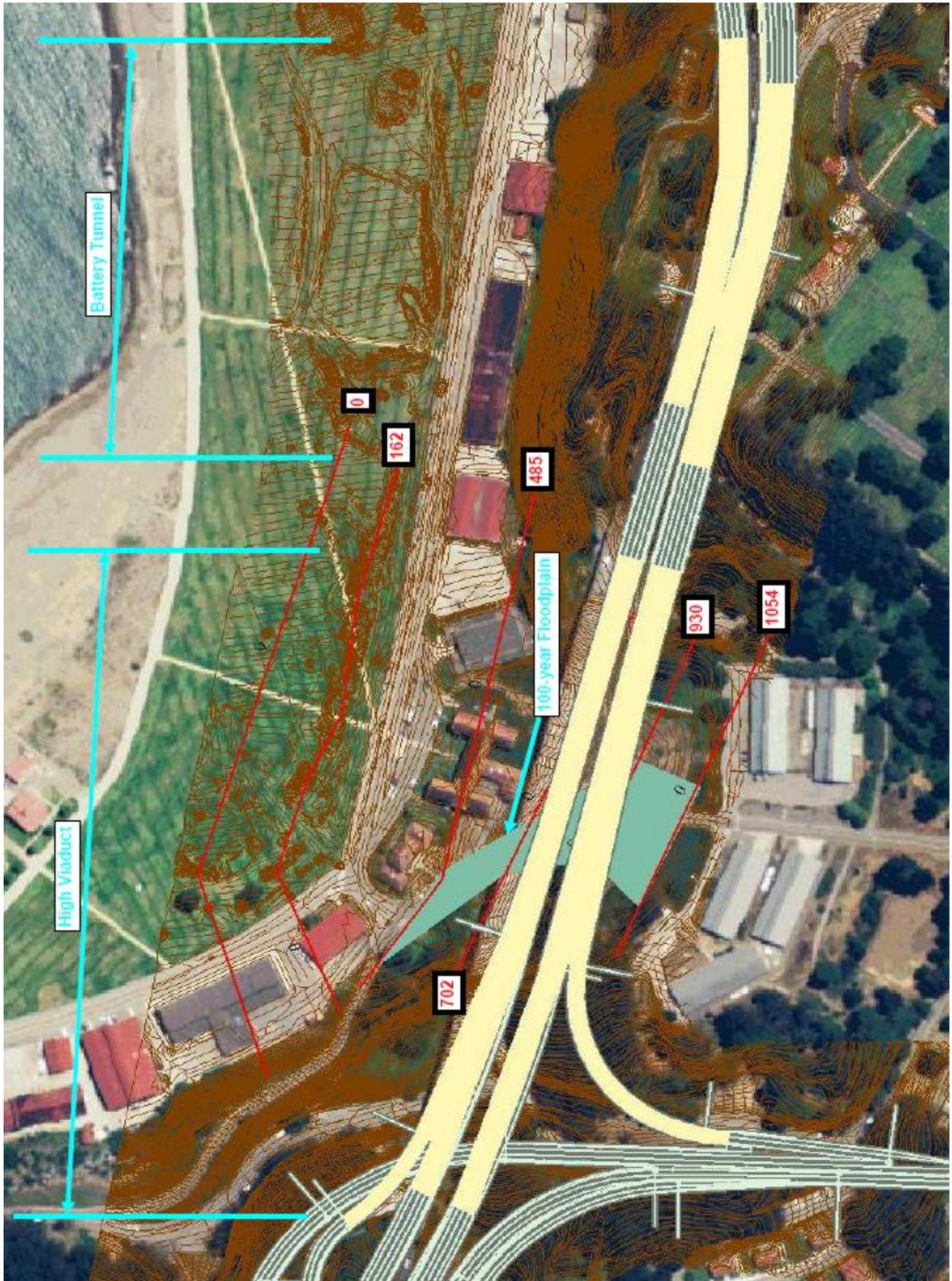
Water Surface Elevation (ft NAVD 88)				
River Sta	50-year	100-year	500-year	Remarks
0	14.9	15.2	15.8	
162	15.2	15.3	15.9	
485	15.8	15.9	15.9	
702	28.7	28.8	29.2	DS Doyle Drive
930	44.3	44.4	44.5	US Doyle Drive
1054	51.6	51.7	51.9	
Velocity (fps)				
0	2.7	2.9	3.1	
162	3.1	3.3	0.3	
485	3.2	2.3	3.0	
702	6.6	6.9	7.1	DS Doyle Drive
930	2.2	2.3	2.5	US Doyle Drive
1054	5.5	5.7	6.1	

Table 5 shows the 50-year and 100-year freeboard. The project meets Caltrans' freeboard criterion which states that the 50-year flood must have enough freeboard to pass any anticipated drift and the 100-year flood must be able to pass the flood with no freeboard requirements and that a minimum freeboard of 0.6 meter (2 feet) is often assumed for planning studies.

Table 5: 50-year and 100-year Freeboard

Bridge	Center Line Station	Minimum Low Chord Elevation (feet NAVD 1988)	Water Surface Elevation (feet NAVD 1988)	Freeboard (ft)
50-year Freeboard				
High Viaduct NB	93+75	117.3	28.7	88.6
High Viaduct SB	93+40	115.8	44.3	71.5
100-year Freeboard				
High Viaduct NB	93+75	117.3	28.8	88.5
High Viaduct SB	93+40	115.8	44.4	71.4

Figure 6: High Viaduct 100-year Floodplain



5 Scour Method and Analysis

5.1 Approach

The proposed high viaduct was checked for scour at the piers. Pier scour was calculated using the Colorado State University (CSU) equation, with the water surface elevations and velocities computed in this study (Reference 3). The CSU equation is as follows:

$$\frac{Y_s}{a} = 2.0K_1K_2K_3 \left[\frac{y_1}{a} \right]^{0.35} F^{0.43}$$

Where:

K_1 correction factor for pier nose shape, Table 2, HEC 18, page 40

K_2 correction factor for angle of attack of flow, Table 3, HEC 18, page 40

K_3 correction factor for bed conditions, Table 1, HEC 18, page 39

a pier width, ft

y_1 flow depth directly upstream from bridge, ft

F Froude number

Y_s scour depth

5.2 Scour Results

The above information was used to determine the potential pier scour at the proposed causeway. The results are based on the 100-year velocities and assumed soil gradation for the bridge site. Soil gradation information is not available for the bridge site. The soil gradation for the scour analysis was assumed based on Natural Resource Service soil descriptions. The analysis should be repeated to obtain a better estimate of the potential scour once the geotechnical analysis for the site is completed. The maximum pier scour is approximately 6.1 feet. The scour calculations are included in the Appendix B of this report.

6 Conclusions and Recommendations

The proposed Doyle Drive minimum low chord elevation of 66 feet NAVD will provide a freeboard of approximately 37.5 feet for the 100-year water surface elevation of 28.5 feet NAVD and a freeboard of approximately 37.6 feet over the 50-year event (Table 5).

Table 5: Hydrologic Summary

Drainage Area: 229 acres			
Frequency (Years)	Design Flood	Base Flood	Flood of Record
	50	100	N/A
Discharge (Cubic feet per second)	464	530	N/A
Water Surface (Elevation at Bridge) (feet NAVD)	44.3	44.4	N/A
<i>Flood plain data are based upon information available when the plans were prepared and are shown to meet Federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation</i>			

7 References and Bibliography

- [1] OSFP Information and Procedures Guide, June 20027
- [2] Dames & Moore. *Presidio of San Francisco Storm Water Management Plan*, October 1994.
- [3] HEC-18 - Evaluating Scour at Bridges, Resource Consultants and Engineers, National Highway Institute, Federal Highway Administration, 6200 Georgetown Pike, Mclean, Virginia 22101.
- [4] United States Environmental Protection Agency. *The Probability of Sea Level Rise*, EPA 230-R-95-008. October 1995.
- [5] Houston, J.R. and A.W. Garcia. Type 16 Flood Insurance Study: Tsunami Predictions for Monterey and San Francisco Bays and Puget Sound, Technical Report H-75-17, November 1975
- [6] Manna Consultants. *Draft Technical Memorandum, Location Hydraulics Study* .November 17, 2000.

8 Appendices

Appendix A: Hydrology

Rainfall Depth Duration Frequency

Station	Statio No	County	Lat	Long.	Elev.	Source	Yrs Rec	Slope	Intercep
San Francisco City	E70 7772 00	San Fr: #####	#####		50	HPD	116	0.459	0.561

Maximum Rainfall For Indicated Number Of Concecutive Days													
	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	1 Day	2 Day	3 Day	C-Yr
RP 2	0.16	0.23	0.28	0.37	0.50	0.71	0.85	1.20	1.59	2.11	#DIV/0!	#DIV/0!	20.84
RP 5	0.23	0.32	0.39	0.53	0.71	1.00	1.20	1.68	2.24	2.96	#DIV/0!	#DIV/0!	27.25
RP 10	0.27	0.38	0.47	0.63	0.85	1.19	1.43	2.01	2.67	3.53	#DIV/0!	#DIV/0!	30.95
RP 25	0.32	0.46	0.56	0.75	1.02	1.43	1.72	2.41	3.22	4.25	#DIV/0!	#DIV/0!	35.19
RP 50	0.36	0.52	0.63	0.85	1.14	1.61	1.94	2.71	3.61	4.77	#DIV/0!	#DIV/0!	38.09
RP 100	0.40	0.58	0.70	0.94	1.27	1.78	2.15	3.00	4.00	5.29	#DIV/0!	#DIV/0!	40.80
RP 200	0.44	0.63	0.77	1.03	1.39	1.95	2.35	3.29	4.39	5.80	#DIV/0!	#DIV/0!	43.37
RP 500	0.49	0.70	0.86	1.15	1.55	2.18	2.62	3.67	4.90	6.47	#DIV/0!	#DIV/0!	46.62
RP 1000	0.53	0.76	0.93	1.24	1.67	2.35	2.83	3.96	5.28	6.97	#DIV/0!	#DIV/0!	48.97
RP 10000	0.66	0.94	1.15	1.53	2.07	2.91	3.51	4.91	6.54	8.64	#DIV/0!	#DIV/0!	56.35

Average	0.18	0.25	0.31	0.41	0.55	0.77	0.93	1.31	1.74	2.30	#DIV/0!	#DIV/0!	21.43
Stdev	0.06	0.09	0.11	0.14	0.18	0.22	0.30	0.46	0.69	0.96	#DIV/0!	#DIV/0!	7.03
Rec Max	0.38	0.51	0.65	0.83	1.07	1.46	2.27	4.00	6.00	7.76	0.00	0.00	45.59
Rec Min	0.07	0.09	0.11	0.18	0.26	0.37	0.46	0.74	0.89	1.17	0.00	0.00	9.00
Z	2.90	2.57	2.79	2.56	2.33	2.20	3.55	5.11	6.06	5.89	#DIV/0!	#DIV/0!	3.35
Yrs Rec	78	78	78	78	97	98	116	116	116	116	0	0	115
Calc CV	0.343	0.356	0.363	0.350	0.325	0.290	0.326	0.350	0.397	0.420	#DIV/0!	#DIV/0!	0.328
Reg CV	.404	.404	.404	.404	.404	.404	.404	.404	.404	.404	.431	.426	.336
Skew	0.9	0.9	0.9	0.9	0.7	0.9	1.8	2.8	3.3	2.7	#DIV/0!	#DIV/0!	0.9
Reg Skew	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.4	1.4	0.5
Kurtosis	0.9	0.5	0.5	0.6	-0.1	0.5	4.5	12.2	16.1	11.1	#DIV/0!	#DIV/0!	1.5

Maximum Rainfall For Indicated Number Of Concecutive Days

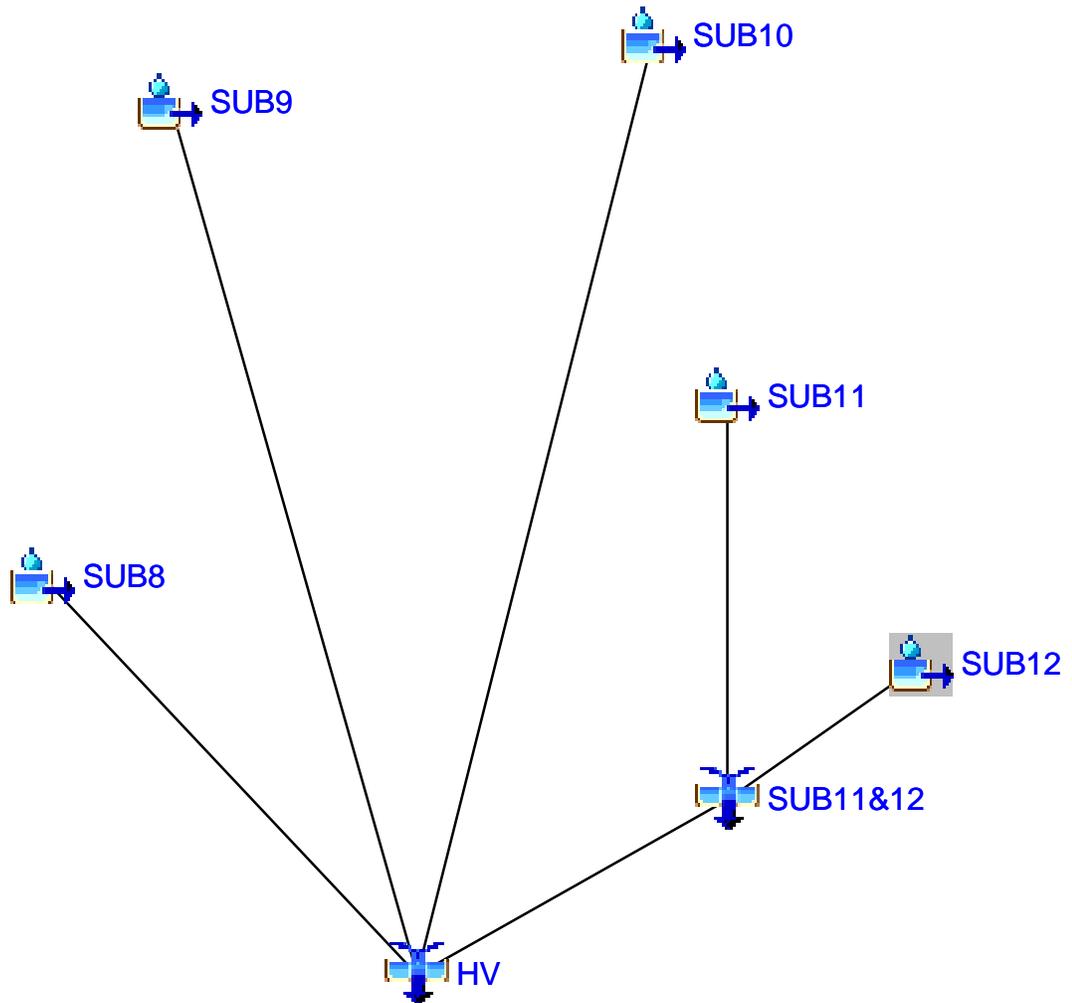


HEC-HMS

Project : HMS-NEW

Basin Model : Basin 1

Jul 25 08:30:54 PDT 2009



Project: HMS-NEW Simulation Run: 2-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 2-year
Compute Time: 25Jul2009, 08:31:49 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	170.7	15Jul2008, 10:05	1.72
SUB10	0.0847	37.7	15Jul2008, 10:05	1.72
SUB11	0.0554	22.5	15Jul2008, 10:05	1.60
SUB11&12	0.0928	39.2	15Jul2008, 10:05	1.57
SUB12	0.0374	16.7	15Jul2008, 10:05	1.53
SUB8	0.0699	39.7	15Jul2008, 10:05	1.84
SUB9	0.1100	54.1	15Jul2008, 10:05	1.76

Project: HMS-NEW Simulation Run: 10-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 10-year
Compute Time: 25Jul2009, 08:31:40 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	320.9	15Jul2008, 10:05	2.92
SUB10	0.0847	73.1	15Jul2008, 10:05	2.91
SUB11	0.0554	43.8	15Jul2008, 10:05	2.73
SUB11&12	0.0928	74.0	15Jul2008, 10:05	2.68
SUB12	0.0374	31.7	15Jul2008, 10:00	2.61
SUB8	0.0699	73.2	15Jul2008, 10:00	3.11
SUB9	0.1100	101.8	15Jul2008, 10:05	3.00

Project: HMS-NEW Simulation Run: 25-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 25-year
Compute Time: 25Jul2009, 08:31:45 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	399.2	15Jul2008, 10:00	3.53
SUB10	0.0847	91.1	15Jul2008, 10:05	3.53
SUB11	0.0554	54.9	15Jul2008, 10:05	3.30
SUB11&12	0.0928	91.9	15Jul2008, 10:05	3.24
SUB12	0.0374	40.0	15Jul2008, 10:00	3.15
SUB8	0.0699	92.5	15Jul2008, 10:00	3.76
SUB9	0.1100	128.6	15Jul2008, 10:00	3.64

Project: HMS-NEW Simulation Run: 50-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 50-year
Compute Time: 25Jul2009, 08:31:59 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	464.1	15Jul2008, 10:00	3.98
SUB10	0.0847	104.6	15Jul2008, 10:05	3.97
SUB11	0.0554	63.1	15Jul2008, 10:05	3.71
SUB11&12	0.0928	106.1	15Jul2008, 10:00	3.65
SUB12	0.0374	46.0	15Jul2008, 10:00	3.55
SUB8	0.0699	107.2	15Jul2008, 10:00	4.23
SUB9	0.1100	149.2	15Jul2008, 10:00	4.11

Project: HMS-NEW Simulation Run: 100-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 100-year
Compute Time: 25Jul2009, 08:31:35 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	530.3	15Jul2008, 10:00	4.43
SUB10	0.0847	118.3	15Jul2008, 10:05	4.43
SUB11	0.0554	71.2	15Jul2008, 10:05	4.13
SUB11&12	0.0928	121.3	15Jul2008, 10:00	4.06
SUB12	0.0374	52.2	15Jul2008, 10:00	3.94
SUB8	0.0699	121.9	15Jul2008, 10:00	4.70
SUB9	0.1100	171.2	15Jul2008, 10:00	4.58

Project: HMS-NEW Simulation Run: 500-year

Start of Run: 15Jul2008, 00:00 Basin Model: Basin 1
End of Run: 16Jul2008, 00:05 Meteorologic Model: 500-yaer
Compute Time: 25Jul2009, 08:31:54 Control Specifications: Control 1

Volume Units: IN

Hydrologic Element	Drainage Area (MI ²)	Peak Discharge (CFS)	Time of Peak	Volume (IN)
HV	0.3574	684.8	15Jul2008, 10:00	5.47
SUB10	0.0847	151.9	15Jul2008, 10:00	5.47
SUB11	0.0554	89.7	15Jul2008, 10:00	5.10
SUB11&12	0.0928	156.0	15Jul2008, 10:00	5.00
SUB12	0.0374	66.3	15Jul2008, 10:00	4.84
SUB8	0.0699	154.5	15Jul2008, 10:00	5.78
SUB9	0.1100	222.4	15Jul2008, 10:00	5.67

National Flood Frequency Program
 Version 3.0
 Based on Water-Resources Investigations Report 02-4168
 Equations from database C:\Program Files\NFF\NFFv3.2_2004-12-14.mdb
 Updated by kries 9/22/2004 at 4:03:24 PM fixed decimal place in constant
 Equations for California developed using English units

Site: High Viaduct, California
 User: touray
 Date: Saturday, July 25, 2009 09:27 AM

Rural Estimate: Rural 2
 Basin Drainage Area: 0.36 mi2
 1 Region
 Region: Central_Coast_Region
 Drainage_Area = 0.36 mi2
 Mean_Annual_Precipitation = 21.4 in
 Altitude_Index = 0.1 thousand feet
 Crippen & Bue Region 17

Urban Estimate: Urban 2
 Basin Drainage Area: 0.36 mi2
 1 Region
 Region: National Urban
 Drainage_Area = 0.36 mi2
 Channel_Slope = 70 ft per mi
 2-hour_2-year_Rainfall_Intensity = 2.49 in
 Basin_Storage = 0 percent
 Basin_Development_Factor = 5 dimensionless
 Impervious_Surfaces = 19 percent
 Rural Scenario = Rural 2

Flood Peak Discharges, in cubic feet per second

Estimate	Recurrence Interval, yrs	Peak, cfs	Standard Error, %	Equivalent Years
Rural 2	2	71.3	150	
	5	112	110	
	10	140	96	
	25	175	96	
	50	198	110	
	100	223	120	
	500	278		
	maximum: 2260 (for C&B region 17)			
Urban 2	2	160	38	
	5	244	37	
	10	306	38	
	25	370	40	
	50	434	42	
	100	489	44	
	500	600	49	

Appendix B: Hydraulics

HEC-RAS Version 4.0.0 March 2008
 U.S. Army Corps of Engineers
 Hydrologic Engineering Center
 609 Second Street
 Davis, California

```

X   X  XXXXXX   XXXX       XXXX       XX       XXXX
X   X  X        X   X      X   X      X   X      X
X   X  X        X         X   X      X   X      X
XXXXXXXX XXXX   X         XXX XXXX   XXXXXXX XXXX
X   X  X        X         X   X      X   X          X
X   X  X        X   X      X   X      X   X          X
X   X  XXXXXX   XXXX       X   X      X   X      XXXXX
  
```

PROJECT DATA

Project Title: High Viaduct
 Project File : HV.prj
 Run Date and Time: 7/24/2009 4:36:30 PM

Project in English units

PLAN DATA

Plan Title: Scour
 Plan File : C:\Desktop\Doyle\OUTBOX\Models\RAS\HV.p02

Geometry Title: High Viaduct
 Geometry File : C:\Desktop\Doyle\OUTBOX\Models\RAS\HV.g01

Flow Title : High Viaduct
 Flow File : C:\Desktop\Doyle\OUTBOX\Models\RAS\HV.f02

Plan Summary Information:

Number of:	Cross Sections =	6	Multiple Openings =	0
	Culverts =	0	Inline Structures =	0
	Bridges =	1	Lateral Structures =	0

Computational Information

Water surface calculation tolerance = 0.01
 Critical depth calculation tolerance = 0.01
 Maximum number of iterations = 20
 Maximum difference tolerance = 0.3
 Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
 Conveyance Calculation Method: At breaks in n values only
 Friction Slope Method: Average Conveyance
 Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: High Viaduct
 Flow File : C:\Desktop\Doyle\OUTBOX\Models\RAS\HV.f02

Flow Data (cfs)

River	Reach	RS	2-year	10-year	25-year
50-year	100-year	500-year			
High	Viaduct	1054	171	321	399
464	530	685			

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
High	Viaduct	2-year		Normal S = 0.002
High	Viaduct	10-year		Normal S = 0.002
High	Viaduct	25-year		Normal S = 0.002
High	Viaduct	50-year		Normal S = 0.002
High	Viaduct	100-year		Normal S = 0.002
High	Viaduct	500-year		Normal S = 0.002

GEOMETRY DATA

Geometry Title: High Viaduct
 Geometry File : C:\Desktop\Doyle\OUTBOX\Models\RAS\HV.g01

CROSS SECTION

RIVER: High
 REACH: Viaduct RS: 1054

INPUT

Description:

Station Elevation Data		num=		266					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	65.9	2.2	65.7	4.4	65.7	6.6	65.5	8.8	65
11	64.3	13.2	64.3	15.4	64.2	17.6	64	19.8	63.2
22	63.3	24.2	62.6	26.4	62.6	28.6	62	30.8	61.6
33	61.6	35.2	61.5	37.4	62.3	39.6	62.1	41.9	62.6
44.1	62.3	46.3	61.7	48.5	60.7	50.7	60.4	52.9	60.4
55.1	60.8	57.3	59.9	59.5	59.6	61.7	59.9	63.9	59.5
68.3	59.5	70.5	59.6	72.7	59.5	74.9	59.5	77.1	59.4
85.9	59.4	88.1	58.7	92.5	58.7	96.9	58.5	99.1	58.5
101.3	58.4	103.5	58.4	105.7	58.3	107.9	58.4	110.1	58.3
112.3	58.4	114.5	57.9	116.7	57.6	118.9	57.6	121.2	57.5
123.4	57.6	125.6	57.5	127.8	57.6	134.4	57.3	136.6	57.3
138.8	56.8	141	56.8	143.2	56.7	145.4	56.5	149.8	56.3
152	56.1	154.2	55.8	156.4	55.6	158.6	55.5	163	55.1
165.2	55	171.8	55	174	54.5	176.2	54.8	178.4	54.7
180.6	55	182.8	55	185	55.1	187.2	55.1	189.4	55.3
191.6	55.2	193.8	55.3	196	55.2	198.2	55.3	200.4	55.3
202.7	55.2	204.9	55.3	207.1	55.2	209.3	55.3	211.5	55.3
213.7	55.1	215.9	54.7	218.1	55	222.5	55	224.7	54.9
231.3	54.9	235.7	54.7	237.9	54.8	240.1	54.7	242.3	54.7
244.5	54.6	246.7	54.7	248.9	54.5	253.3	54.5	255.5	54.4
259.9	54.4	262.1	54.5	264.3	54.4	266.5	54.5	273.1	54.5
275.3	54.6	279.7	54.6	282	54.5	284.2	54.5	286.4	54.4
288.6	54.4	293	54.2	299.6	54.2	301.8	54.1	304	54.1
306.2	53.9	310.6	53.7	315	53.7	317.2	53.6	319.4	53.6
321.6	53.1	323.8	52.9	326	52.3	328.2	51.7	330.4	51.5
332.6	50.8	334.8	50.6	337	50.4	339.2	50.4	341.4	50.4
343.6	50.4	345.8	50.2	348	50.5	350.2	50.1	352.4	49.9
354.6	49.7	356.8	49.9	359	49.8	361.2	50.1	363.5	50.2
365.7	50.3	367.9	50.4	370.1	50.5	372.3	50.5	374.5	50.5
376.7	50.5	378.9	50.5	381.1	50.8	383.3	50.8	385.5	51
387.7	51	389.9	51	392.1	51	394.3	51	396.5	51
398.7	51	400.9	51	403.1	51	405.3	51	407.5	51
409.7	51	411.9	51	414.1	51.2	416.3	51.2	418.5	51.6
420.7	51.4	422.9	51.6	425.1	51.6	427.3	52.1	429.5	52
431.7	52.5	433.9	52.8	436.1	52.8	438.3	53	440.5	53
442.8	53.3	445	53	447.2	53.6	449.4	53	451.6	54
453.8	53.8	456	54.5	458.2	54.2	460.4	54.5	462.6	55
464.8	55.2	467	55.9	469.2	56	471.4	56.2	473.6	56.5
475.8	56.7	478	56.6	480.2	56.8	482.4	56.8	484.6	57
489	56.8	491.2	57	493.4	57	495.6	57.3	497.8	57.2
500	57.3	502.2	57.3	504.4	57.5	508.8	57.5	511	57.6
513.2	57.8	517.6	58	535.3	58	537.5	58.1	539.7	58.1
541.9	58.3	550.7	58.3	552.9	58.5	559.5	58.5	561.7	58.6
568.3	58.6	570.5	59.4	574.9	59.4	577.1	59.5	585.9	59.5

588.1	59.6	596.9	59.6	599.1	59.7	603.6	59.7	605.8	60
608	60	610.2	60.2	612.4	60.2	619	60.5	621.2	60.5
623.4	60.6	625.6	60.6	627.8	60.7	630	60.7	632.2	60.8
636.6	61.2	638.8	61.5	641	61.5	643.2	61.8	645.4	62
654.2	62	656.4	62.1	658.6	62.6	660.8	62.7	663	63
665.2	63	667.4	63.1	669.6	63.3	671.8	64	674	64
676.2	64.4	678.4	64.4	682.8	65.6	685.1	65.8	687.3	66.4
693.9	66.7	696.1	67.3	698.3	67.7	704.9	68	707.1	68.2
709.3	68.7	711.5	68.8	713.7	69.1	715.9	69.3	718.1	69.6
720.3	70								

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .06 321.6 .06 433.9 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 321.6 433.9 124 124 124 .1 .3

CROSS SECTION

RIVER: High
 REACH: Viaduct RS: 930

INPUT

Description:

Station Elevation Data num= 258

Sta	Elev								
0	54.1	2.2	54	4.4	53.3	6.6	53	8.8	52.8
10.9	52	13.1	52	15.3	51.2	17.5	51.2	19.7	50.8
21.9	50.2	24.1	50.2	26.3	49.8	28.4	49.7	30.6	49.1
32.8	49	35	47.8	37.2	47.9	39.4	47.7	41.6	47.6
43.8	47.8	45.9	47.6	48.1	48	50.3	47.8	52.5	47.7
54.7	47.4	56.9	47.4	61.3	46.4	63.4	46.7	65.6	47
67.8	47	70	47.2	72.2	47.2	74.4	47.3	78.8	47.3
81	47.5	83.1	47.8	85.3	47.6	87.5	48	89.7	48
91.9	48.2	94.1	48	96.3	48.2	98.5	48.1	100.6	48
102.8	48.3	105	48.2	107.2	48.2	109.4	48	111.6	48.2
113.8	47.9	116	48.4	118.1	48.4	120.3	48.3	122.5	48.3
126.9	48.1	129.1	47.9	131.3	47.9	133.5	47.7	137.8	47.7
140	47.6	144.4	47.2	153.2	46.8	159.7	46.8	161.9	47.2
164.1	47.2	166.3	47.3	170.7	47.1	172.8	47	175	47
177.2	46.9	179.4	46.7	181.6	46.4	183.8	46	192.5	46
194.7	45.8	196.9	45.9	199.1	45.7	201.3	45.8	203.5	45.7
205.7	45.8	207.9	45.3	210	45.4	212.2	45.1	214.4	44.7
216.6	44.2	221	44.2	225.4	43.8	227.5	43.8	229.7	44
231.9	43.9	234.1	43.9	236.3	44	247.2	44	249.4	44.1
251.6	44	253.8	44	256	44.6	258.2	44.5	260.4	44.9
262.5	44.1	264.7	44.7	266.9	43.9	269.1	44.2	271.3	44.3
273.5	44.1	275.7	44.5	277.9	44.4	282.2	44.4	284.4	44.3
291	44.3	295.4	44.1	297.6	43.7	299.7	43.5	304.1	43.1
306.3	43	310.7	43	315.1	43.8	317.2	43.8	319.4	44
321.6	44	326	43.8	328.2	43.8	332.6	43.6	334.7	43.6
336.9	43.5	339.1	43.6	341.3	43.4	343.5	43.4	345.7	43.3
347.9	43.6	350.1	43.7	352.3	43.7	354.4	43.9	356.6	43.9
358.8	44	361	44	363.2	43.7	365.4	43.5	369.8	43.3
371.9	43	374.1	43.1	376.3	43	378.5	43	380.7	42.9
382.9	43	385.1	42.8	387.3	43	389.4	43	391.6	42.9
393.8	42.7	396	42.6	398.2	42.8	400.4	42.8	402.6	42.7
404.8	42.6	407	42.5	409.1	42.3	411.3	42.3	413.5	42.3
415.7	42.4	417.9	42.5	420.1	42.5	422.3	42.5	424.5	42.6
426.6	42.7	428.8	42.5	431	42.6	433.2	42.6	435.4	42.6
437.6	42.6	439.8	42.6	442	42.6	444.1	42.6	446.3	42.6
448.5	43.1	452.9	43.1	455.1	43.3	457.3	43.4	459.5	43.4
461.6	43.5	466	43.7	470.4	43.7	472.6	43.8	474.8	43.8
479.2	44	492.3	44	494.5	44.2	496.7	44.3	498.8	44.4
501	44.6	505.4	44.6	507.6	45	512	45.4	514.2	45.5
520.7	45.5	529.5	46.3	531.7	46.3	533.8	46.5	538.2	46.5
540.4	47.3	542.6	47.6	547	47.6	551.4	47.8	553.5	48.3
555.7	48.5	557.9	48.5	560.1	48.7	562.3	48.7	564.5	48.8
566.7	49.1	568.9	49.3	571	49.7	573.2	49.9	575.4	50
577.6	50	582	50.6	584.2	51	597.3	51	599.5	52
614.8	52	617	52.2	619.2	52.9	621.4	53	632.3	53
634.5	53.3	636.7	53.7	638.9	54	645.4	54	647.6	54.1

649.8	54.6	652	54.9	654.2	55	656.4	55	658.6	55.3
660.7	55.7	662.9	56	667.3	56	673.9	56.9	676.1	57.3
678.3	57.6	680.4	57.7	682.6	58.2	684.8	58.4	687	58.5
689.2	58.9	691.4	59.5	693.6	59.5	695.8	59.9	697.9	60.4
700.1	60.4	702.3	61.2	708.9	62.4	711.1	62.6	713.3	63.6
715.4	63.8	717.6	64.7	719.8	65.2				

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 0 .06 719.8 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 0 719.8 228 228 228 .1 .3

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 0 54.1 F
 719.8 719.8 65.2 F

BRIDGE

RIVER: High
 REACH: Viaduct RS: 816

INPUT

Description:
 Distance from Upstream XS = 10
 Deck/Roadway Width = 200
 Weir Coefficient = 2.6
 Upstream Deck/Roadway Coordinates
 num= 2
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord
 0 60 55 700 60 55

Upstream Bridge Cross Section Data

Station Elevation Data num= 258

Sta	Elev								
0	54.1	2.2	54	4.4	53.3	6.6	53	8.8	52.8
10.9	52	13.1	52	15.3	51.2	17.5	51.2	19.7	50.8
21.9	50.2	24.1	50.2	26.3	49.8	28.4	49.7	30.6	49.1
32.8	49	35	47.8	37.2	47.9	39.4	47.7	41.6	47.6
43.8	47.8	45.9	47.6	48.1	48	50.3	47.8	52.5	47.7
54.7	47.4	56.9	47.4	61.3	46.4	63.4	46.7	65.6	47
67.8	47	70	47.2	72.2	47.2	74.4	47.3	78.8	47.3
81	47.5	83.1	47.8	85.3	47.6	87.5	48	89.7	48
91.9	48.2	94.1	48	96.3	48.2	98.5	48.1	100.6	48
102.8	48.3	105	48.2	107.2	48.2	109.4	48	111.6	48.2
113.8	47.9	116	48.4	118.1	48.4	120.3	48.3	122.5	48.3
126.9	48.1	129.1	47.9	131.3	47.9	133.5	47.7	137.8	47.7
140	47.6	144.4	47.2	153.2	46.8	159.7	46.8	161.9	47.2
164.1	47.2	166.3	47.3	170.7	47.1	172.8	47	175	47
177.2	46.9	179.4	46.7	181.6	46.4	183.8	46	192.5	46
194.7	45.8	196.9	45.9	199.1	45.7	201.3	45.8	203.5	45.7
205.7	45.8	207.9	45.3	210	45.4	212.2	45.1	214.4	44.7
216.6	44.2	221	44.2	225.4	43.8	227.5	43.8	229.7	44
231.9	43.9	234.1	43.9	236.3	44	247.2	44	249.4	44.1
251.6	44	253.8	44	256	44.6	258.2	44.5	260.4	44.9
262.5	44.1	264.7	44.7	266.9	43.9	269.1	44.2	271.3	44.3
273.5	44.1	275.7	44.5	277.9	44.4	282.2	44.4	284.4	44.3
291	44.3	295.4	44.1	297.6	43.7	299.7	43.5	304.1	43.1
306.3	43	310.7	43	315.1	43.8	317.2	43.8	319.4	44
321.6	44	326	43.8	328.2	43.8	332.6	43.6	334.7	43.6
336.9	43.5	339.1	43.6	341.3	43.4	343.5	43.4	345.7	43.3
347.9	43.6	350.1	43.7	352.3	43.7	354.4	43.9	356.6	43.9
358.8	44	361	44	363.2	43.7	365.4	43.5	369.8	43.3
371.9	43	374.1	43.1	376.3	43	378.5	43	380.7	42.9
382.9	43	385.1	42.8	387.3	43	389.4	43	391.6	42.9
393.8	42.7	396	42.6	398.2	42.8	400.4	42.8	402.6	42.7
404.8	42.6	407	42.5	409.1	42.3	411.3	42.3	413.5	42.3
415.7	42.4	417.9	42.5	420.1	42.5	422.3	42.5	424.5	42.6
426.6	42.7	428.8	42.5	431	42.6	433.2	42.6	435.4	42.6
437.6	42.6	439.8	42.6	442	42.6	444.1	42.6	446.3	42.6
448.5	43.1	452.9	43.1	455.1	43.3	457.3	43.4	459.5	43.4
461.6	43.5	466	43.7	470.4	43.7	472.6	43.8	474.8	43.8

479.2	44	492.3	44	494.5	44.2	496.7	44.3	498.8	44.4
501	44.6	505.4	44.6	507.6	45	512	45.4	514.2	45.5
520.7	45.5	529.5	46.3	531.7	46.3	533.8	46.5	538.2	46.5
540.4	47.3	542.6	47.6	547	47.6	551.4	47.8	553.5	48.3
555.7	48.5	557.9	48.5	560.1	48.7	562.3	48.7	564.5	48.8
566.7	49.1	568.9	49.3	571	49.7	573.2	49.9	575.4	50
577.6	50	582	50.6	584.2	51	597.3	51	599.5	52
614.8	52	617	52.2	619.2	52.9	621.4	53	632.3	53
634.5	53.3	636.7	53.7	638.9	54	645.4	54	647.6	54.1
649.8	54.6	652	54.9	654.2	55	656.4	55	658.6	55.3
660.7	55.7	662.9	56	667.3	56	673.9	56.9	676.1	57.3
678.3	57.6	680.4	57.7	682.6	58.2	684.8	58.4	687	58.5
689.2	58.9	691.4	59.5	693.6	59.5	695.8	59.9	697.9	60.4
700.1	60.4	702.3	61.2	708.9	62.4	711.1	62.6	713.3	63.6
715.4	63.8	717.6	64.7	719.8	65.2				

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 0 .06 719.8 .06

Bank Sta: Left Right Coeff Contr. Expan.
 0 719.8 .1 .3

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 0 54.1 F
 719.8 719.8 65.2 F

Downstream Deck/Roadway Coordinates num= 2
 Sta Hi Cord Lo Cord Sta Hi Cord Lo Cord
 0 60 55 781 60 55

Downstream Bridge Cross Section Data Station Elevation Data num= 339

Sta	Elev								
0	52.1	2.2	50.9	4.4	50.2	6.6	49.2	8.9	49
11.1	47.4	13.3	47	15.5	45.7	19.9	44.5	22.1	44.6
24.3	43.4	26.6	42.4	28.8	41.8	31	40.7	33.2	41
35.4	40.3	37.6	39.8	39.8	38.8	42.1	38.5	44.3	37.5
46.5	37.4	48.7	36.6	50.9	36.2	55.3	35.2	57.5	35
59.8	34.6	62	33.8	64.2	33.8	66.4	33.3	68.6	32.7
70.8	32.8	73	32.5	75.3	32.6	77.5	32.2	79.7	32.2
81.9	31.9	84.1	31.4	86.3	30.4	90.7	29.2	93	29.2
95.2	28.7	97.4	28.1	99.6	27.9	101.8	27.1	104	26.7
106.2	27	108.5	26.3	110.7	26.3	112.9	26.6	115.1	26.5
117.3	26.7	119.5	26.7	121.7	26.8	123.9	26.8	126.2	27.1
128.4	27.1	130.6	27.6	132.8	27.7	135	27.9	137.2	27.9
139.4	28	141.7	28	143.9	28.5	146.1	28.5	148.3	29
150.5	29.1	152.7	29.1	154.9	29.2	157.1	29.4	159.4	29.5
161.6	29.5	163.8	29.6	166	29.4	168.2	29.8	170.4	29.8
172.6	30	174.9	29.7	177.1	29.6	179.3	29.6	181.5	29.8
183.7	29.7	185.9	29.8	188.1	29.4	190.3	29.9	192.6	29.8
199.2	29.8	205.8	30.1	210.3	30.1	212.5	29.8	214.7	29.6
216.9	29.6	219.1	29.7	223.5	29.7	225.8	29.5	228	29.8
230.2	29	232.4	29.5	234.6	29.5	236.8	29.4	239	29.4
241.3	29.2	243.5	29.5	250.1	29.5	252.3	30.1	254.5	30
256.7	30.2	259	30.2	261.2	30.3	263.4	30.3	265.6	30.7
267.8	30.5	270	30.8	276.7	30.8	278.9	31.5	281.1	31.6
285.5	31.6	287.7	31.7	289.9	31.7	292.2	31.9	294.4	32.3
296.6	32.4	298.8	32.3	301	31.6	303.2	31.7	305.4	31.7
307.7	31.8	309.9	31.4	312.1	31.4	314.3	31.5	316.5	31.7
318.7	32	320.9	31.8	323.1	31.7	325.4	31.7	327.6	31.6
329.8	31.6	332	32.2	334.2	32.1	336.4	32.1	338.6	32
340.9	32	343.1	32.1	345.3	32.3	351.9	32.6	354.1	33
360.8	33	363	33.2	365.2	33.2	367.4	33.3	369.6	33.6
371.8	33.6	374.1	33.8	382.9	33.8	385.1	33.9	387.3	33.9
389.5	34.1	391.8	34.2	394	34.1	400.6	34.1	402.8	33.7
405	33.7	407.3	33.4	409.5	33.2	411.7	33.3	413.9	33.1
416.1	33.4	418.3	33.3	420.5	33	422.7	32.8	425	32.9
427.2	32.6	429.4	32.8	431.6	32.2	433.8	32.5	436	32.5
438.2	32.6	440.5	32.4	444.9	32.2	449.3	32.2	451.5	31.8
453.7	32.1	455.9	32	458.2	32.3	460.4	32.3	462.6	32.4
464.8	32.3	467	32.5	469.2	32.5	471.4	32.3	473.7	32.3
475.9	32.1	478.1	31.8	480.3	31.4	482.5	31.4	484.7	31.5

486.9	31.3	489.1	31.6	498	31.6	500.2	32.1	502.4	32.2
504.6	32.2	506.9	32.3	509.1	32.4	511.3	32.2	513.5	32.4
517.9	32.4	520.1	32.2	522.3	32.2	524.6	32.1	526.8	31.8
529	31.3	531.2	31.1	533.4	31.1	535.6	30.9	537.8	31
540.1	30.7	542.3	31	544.5	30.9	546.7	31.1	548.9	30.8
551.1	30.8	553.3	30.7	557.8	30.7	560	31	562.2	31.1
564.4	31.1	566.6	31	568.8	31.1	571	30.9	573.3	31.1
575.5	31	577.7	31.1	582.1	30.7	584.3	31.1	586.5	30.9
588.7	31.3	591	31.2	593.2	32	597.6	32	599.8	32.2
602	33	604.2	33	606.5	33.2	608.7	33.3	610.9	34
613.1	34	615.3	34.2	617.5	34.2	619.7	34.4	621.9	34.4
624.2	34.8	628.6	35	630.8	35.3	633	35.1	635.2	35.3
637.4	35.3	639.7	35.9	641.9	35.9	644.1	36	646.3	35.9
648.5	36.1	652.9	36.3	659.6	36.3	661.8	37.1	664	37.1
668.4	37.3	670.6	37.3	672.9	37.5	681.7	38.3	683.9	38.8
686.1	40.1	688.3	40.4	690.6	40.7	695	41.3	697.2	41.9
699.4	42.8	703.8	43.2	706.1	43.6	708.3	43.5	710.5	44.2
712.7	44.2	714.9	45	717.1	45.2	719.3	45.7	721.5	45.8
723.8	46.2	726	46.2	728.2	46.8	730.4	47	734.8	47.6
737	48.4	739.3	48.6	741.5	50.1	743.7	50.5	745.9	51.1
748.1	51.6	750.3	51.5	752.5	52.2	754.7	52.1	757	53
759.2	53.7	761.4	54.7	765.8	56.3	768	56.3	770.2	57
772.5	57	774.7	57.4	776.9	58.3	779.1	59	781.3	60
783.5	60.9	785.7	61.2	788	61.8	790.2	62.1	792.4	62
794.6	63.1	796.8	63.3	799	63.6	801.2	63.6	803.4	64.4
805.7	64.5	807.9	65.5	810.1	65.7	812.3	65.8	814.5	66.2
816.7	66.3	818.9	66.8	821.2	66.9	823.4	67	825.6	67.5
827.8	67.5	830	67.7	832.2	67.8	834.4	67.8	836.6	68.3
838.9	68.5	841.1	68.5	845.5	68.7	847.7	69.3		

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 0 .06 847.7 .06

Bank Sta: Left Right Coeff Contr. Expan.
 0 847.7 .1 .3

Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 0 52.1 F
 847.7 847.7 69.3 F

Upstream Embankment side slope = 0 horiz. to 1.0 vertical
 Downstream Embankment side slope = 0 horiz. to 1.0 vertical
 Maximum allowable submergence for weir flow = .98
 Elevation at which weir flow begins =
 Energy head used in spillway design =
 Spillway height used in design =
 Weir crest shape = Broad Crested

Number of Piers = 1

Pier Data
 Pier Station Upstream= 411 Downstream= 411
 Upstream num= 2
 Width Elev Width Elev
 6.5 20 6.5 60
 Downstream num= 2
 Width Elev Width Elev
 6.5 20 6.5 60

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data
 Energy
 Selected Low Flow Methods = Highest Energy Answer

High Flow Method
 Energy Only

Additional Bridge Parameters
 Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: High
REACH: Viaduct RS: 702

INPUT

Description:

Station Elevation Data

num= 339

Sta	Elev								
0	52.1	2.2	50.9	4.4	50.2	6.6	49.2	8.9	49
11.1	47.4	13.3	47	15.5	45.7	19.9	44.5	22.1	44.6
24.3	43.4	26.6	42.4	28.8	41.8	31	40.7	33.2	41
35.4	40.3	37.6	39.8	39.8	38.8	42.1	38.5	44.3	37.5
46.5	37.4	48.7	36.6	50.9	36.2	55.3	35.2	57.5	35
59.8	34.6	62	33.8	64.2	33.8	66.4	33.3	68.6	32.7
70.8	32.8	73	32.5	75.3	32.6	77.5	32.2	79.7	32.2
81.9	31.9	84.1	31.4	86.3	30.4	90.7	29.2	93	29.2
95.2	28.7	97.4	28.1	99.6	27.9	101.8	27.1	104	26.7
106.2	27	108.5	26.3	110.7	26.3	112.9	26.6	115.1	26.5
117.3	26.7	119.5	26.7	121.7	26.8	123.9	26.8	126.2	27.1
128.4	27.1	130.6	27.6	132.8	27.7	135	27.9	137.2	27.9
139.4	28	141.7	28	143.9	28.5	146.1	28.5	148.3	29
150.5	29.1	152.7	29.1	154.9	29.2	157.1	29.4	159.4	29.5
161.6	29.5	163.8	29.6	166	29.4	168.2	29.8	170.4	29.8
172.6	30	174.9	29.7	177.1	29.6	179.3	29.6	181.5	29.8
183.7	29.7	185.9	29.8	188.1	29.4	190.3	29.9	192.6	29.8
199.2	29.8	205.8	30.1	210.3	30.1	212.5	29.8	214.7	29.6
216.9	29.6	219.1	29.7	223.5	29.7	225.8	29.5	228	29.8
230.2	29	232.4	29.5	234.6	29.5	236.8	29.4	239	29.4
241.3	29.2	243.5	29.5	250.1	29.5	252.3	30.1	254.5	30
256.7	30.2	259	30.2	261.2	30.3	263.4	30.3	265.6	30.7
267.8	30.5	270	30.8	276.7	30.8	278.9	31.5	281.1	31.6
285.5	31.6	287.7	31.7	289.9	31.7	292.2	31.9	294.4	32.3
296.6	32.4	298.8	32.3	301	31.6	303.2	31.7	305.4	31.7
307.7	31.8	309.9	31.4	312.1	31.4	314.3	31.5	316.5	31.7
318.7	32	320.9	31.8	323.1	31.7	325.4	31.7	327.6	31.6
329.8	31.6	332	32.2	334.2	32.1	336.4	32.1	338.6	32
340.9	32	343.1	32.1	345.3	32.3	351.9	32.6	354.1	33
360.8	33	363	33.2	365.2	33.2	367.4	33.3	369.6	33.6
371.8	33.6	374.1	33.8	382.9	33.8	385.1	33.9	387.3	33.9
389.5	34.1	391.8	34.2	394	34.1	400.6	34.1	402.8	33.7
405	33.7	407.3	33.4	409.5	33.2	411.7	33.3	413.9	33.1
416.1	33.4	418.3	33.3	420.5	33	422.7	32.8	425	32.9
427.2	32.6	429.4	32.8	431.6	32.2	433.8	32.5	436	32.5
438.2	32.6	440.5	32.4	444.9	32.2	449.3	32.2	451.5	31.8
453.7	32.1	455.9	32	458.2	32.3	460.4	32.3	462.6	32.4
464.8	32.3	467	32.5	469.2	32.5	471.4	32.3	473.7	32.3
475.9	32.1	478.1	31.8	480.3	31.4	482.5	31.4	484.7	31.5
486.9	31.3	489.1	31.6	498	31.6	500.2	32.1	502.4	32.2
504.6	32.2	506.9	32.3	509.1	32.4	511.3	32.2	513.5	32.4
517.9	32.4	520.1	32.2	522.3	32.2	524.6	32.1	526.8	31.8
529	31.3	531.2	31.1	533.4	31.1	535.6	30.9	537.8	31
540.1	30.7	542.3	31	544.5	30.9	546.7	31.1	548.9	30.8
551.1	30.8	553.3	30.7	557.8	30.7	560	31	562.2	31.1
564.4	31.1	566.6	31	568.8	31.1	571	30.9	573.3	31.1
575.5	31	577.7	31.1	582.1	30.7	584.3	31.1	586.5	30.9
588.7	31.3	591	31.2	593.2	32	597.6	32	599.8	32.2
602	33	604.2	33	606.5	33.2	608.7	33.3	610.9	34
613.1	34	615.3	34.2	617.5	34.2	619.7	34.4	621.9	34.4
624.2	34.8	628.6	35	630.8	35.3	633	35.1	635.2	35.3
637.4	35.3	639.7	35.9	641.9	35.9	644.1	36	646.3	35.9
648.5	36.1	652.9	36.3	659.6	36.3	661.8	37.1	664	37.1
668.4	37.3	670.6	37.3	672.9	37.5	681.7	38.3	683.9	38.8
686.1	40.1	688.3	40.4	690.6	40.7	695	41.3	697.2	41.9
699.4	42.8	703.8	43.2	706.1	43.6	708.3	43.5	710.5	44.2
712.7	44.2	714.9	45	717.1	45.2	719.3	45.7	721.5	45.8
723.8	46.2	726	46.2	728.2	46.8	730.4	47	734.8	47.6
737	48.4	739.3	48.6	741.5	50.1	743.7	50.5	745.9	51.1
748.1	51.6	750.3	51.5	752.5	52.2	754.7	52.1	757	53
759.2	53.7	761.4	54.7	765.8	56.3	768	56.3	770.2	57
772.5	57	774.7	57.4	776.9	58.3	779.1	59	781.3	60

783.5	60.9	785.7	61.2	788	61.8	790.2	62.1	792.4	62
794.6	63.1	796.8	63.3	799	63.6	801.2	63.6	803.4	64.4
805.7	64.5	807.9	65.5	810.1	65.7	812.3	65.8	814.5	66.2
816.7	66.3	818.9	66.8	821.2	66.9	823.4	67	825.6	67.5
827.8	67.5	830	67.7	832.2	67.8	834.4	67.8	836.6	68.3
838.9	68.5	841.1	68.5	845.5	68.7	847.7	69.3		

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 0 .06 847.7 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 0 847.7 216.91 216.91 216.91 .1 .3
 Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 0 52.1 F
 847.7 847.7 69.3 F

CROSS SECTION

RIVER: High
 REACH: Viaduct RS: 485

INPUT

Description:

Station Elevation Data num= 325

Sta	Elev								
0	19.7	2.5	19.3	5	19	14.9	19	17.3	18.4
19.8	18	29.7	18	32.2	17.9	34.7	17.4	37.2	17
47.1	17	49.6	16.9	52	16.1	54.5	16	84.3	16
86.7	16.1	91.7	16.1	94.2	16.2	96.7	16.2	101.6	16
104.1	16.1	106.6	15.9	109	16	180.9	16	183.4	16.4
190.8	16.4	193.3	16.6	195.8	16.6	198.3	16.4	200.7	16.5
210.6	16.5	213.1	16.8	215.6	16.7	218.1	17.2	220.6	17.2
223	17.3	225.5	17.2	228	17.4	230.5	17.5	233	17.9
235.4	17.9	237.9	18.1	240.4	18.2	242.9	18.6	245.3	18.6
247.8	19	257.7	19	260.2	19.1	262.7	19.1	265.2	19.6
267.6	20	271.8	20	273.8	20.1	275.9	20.1	277.9	20
280	20.2	284.1	20.5	286.1	20.6	288.2	21.3	292.3	21.4
294.3	21.5	296.4	21.5	298.4	21.6	300.5	21.6	302.5	21.4
304.6	21.5	306.6	21.4	308.7	21.4	310.7	21.5	312.8	21.3
314.9	21.5	316.9	21.4	319	21.5	323.1	21.4	325.1	21.7
329.2	21.7	331.3	21.5	333.3	22.1	335.4	21.9	337.4	21.6
339.5	21.6	341.5	22	343.6	21.6	349.7	21.6	351.8	21.7
353.8	21.6	355.9	21.7	360	21.8	364.1	21.5	366.2	21.7
368.2	21.2	370.3	21.6	372.3	20.9	374.4	21	376.4	21.1
378.5	21.7	380.5	21.1	382.6	21.4	384.6	20.8	386.7	21.2
388.7	20.8	390.8	20	392.8	19.7	394.9	19.5	396.9	19.8
399	19.5	401	18.7	403.1	17.5	405.1	19	407.2	18.5
409.2	18.1	411.3	17.5	413.4	19	415.4	18.2	417.5	16.7
419.5	15.3	421.6	14.4	423.6	14.6	425.7	14.9	429.8	15
431.8	15.2	433.9	15.9	435.9	16	438	16.2	440	17
442.1	17.2	444.1	17.8	446.2	17.6	448.2	17.8	450.3	18
454.4	18	456.4	17.9	458.5	18.3	462.6	18	464.7	18
466.7	18.3	468.8	18.5	472.9	18	474.9	18.7	477	19
479	18.9	481.1	18.8	483.1	18	485.2	17.9	487.2	17.5
489.3	17.3	491.3	16.4	493.4	16.4	495.4	15.9	497.5	15.8
501.6	15.3	503.6	15.8	505.7	15.6	507.7	15.5	509.8	15.4
511.9	16.1	513.9	15.9	516	16.2	520.1	16.5	522.1	16.8
526.2	16.8	528.3	16.5	530.3	16.8	536.5	16.8	538.5	17.3
540.6	17.4	546.7	17.1	548.8	17	552.9	16.3	557	16.2
561.1	15.6	563.2	15.5	565.2	15.7	567.3	15.6	569.3	15.5
571.4	15.3	575.5	15.8	579.6	15.5	583.7	15.9	585.7	15.4
587.8	15.4	589.8	15	591.9	15.3	593.9	14.4	596	13.9
598	13.5	602.1	13.5	604.2	13.6	622.7	13.6	624.7	13.9
626.8	14	630.9	14	632.9	14.1	635	14.3	637	14.8
639.1	14.8	641.1	15.1	643.2	15	645.2	15.1	647.3	15.7
649.3	16.3	651.4	16.7	653.4	16.9	655.5	16.9	657.6	17.1
661.7	17.1	663.7	17.2	665.8	17.3	667.8	17.4	669.9	17.4
671.9	17.3	676	17.3	678.1	17.2	682.2	17.3	686.3	17.3
690.4	17.4	692.4	17.2	694.5	17	696.5	16.7	698.6	16.6
700.6	16.5	702.7	16.3	706.8	16	782.7	16	784.8	15.9
788.9	16	790.9	15.9	793	15.9	797.1	15.8	799.1	15.7

801.2	15.6	805.3	15.6	807.4	15.5	813.5	15.5	815.6	15.2
819.7	15.2	821.7	15	823.8	14.9	827.9	15	840.2	15
842.2	14.9	844.3	14.6	846.3	14.4	848.4	13.6	850.4	13.4
852.5	13.4	854.6	13.2	856.6	13	860.7	13	862.8	12.9
864.8	12.9	866.9	12.6	868.9	12.5	873	12.5	875.1	12.4
883.3	12.4	885.3	12.9	887.4	13	889.4	13.2	891.5	13
893.5	13.1	895.6	13.5	897.6	13.4	899.7	13.6	903.8	13.6
905.9	14.4	910	14	914.1	14.1	916.1	14	922.3	14
924.3	13.9	926.4	13.7	930.5	13.7	932.5	14.2	938.7	14.2
940.7	14.3	942.8	14.2	944.8	14	969.5	14	971.5	14.2
973.6	14.6	977.7	15.4	981.8	15.4	983.8	15.2	985.9	15.4
987.9	15.2	990	15.2	992	15.5	994.1	15.9	996.1	16.4
998.2	16.5	1000.3	17.3	1004.4	17.5	1006.4	18.3	1008.5	18.5
1010.5	18.6	1012.6	19.7	1014.6	20	1016.7	20.1	1018.7	20.3
1020.8	20.9	1024.9	21.5	1026.9	21.8	1029	22.5	1031	23.9
1033.1	24.1	1035.1	24.5	1037.2	24.7	1039.2	25.7	1041.3	25.6
1043.3	25.8	1045.4	25.6	1047.4	27.1	1049.5	27.5	1051.6	27
1053.6	27.2	1055.7	27.5	1057.7	28.2	1059.8	28.2	1063.9	28.7
1065.9	29.9	1068	30.4	1070	30.3	1072.1	30.1	1074.1	30.7

Manning's n Values num= 3
 Sta n Val Sta n Val Sta n Val
 0 .06 864.8 .06 885.3 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 864.8 885.3 322.38 322.38 322.38 .1 .3
 Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 840.53 15.95 F
 903.96 1074.1 15.86 F

CROSS SECTION

RIVER: High
 REACH: Viaduct RS: 162

INPUT

Description:

Station Elevation Data num= 341

Sta	Elev								
0	19.9	2.2	19.7	4.3	19.1	6.5	18	8.7	17.7
10.9	17.5	13	16.7	15.2	16.3	17.4	16.3	19.6	15.1
21.7	14.8	23.9	14.1	26.1	14.1	28.2	14	50	14
52.1	13.9	54.3	13.3	58.7	13.1	60.8	13	119.5	13
121.7	12.7	123.8	12.6	126	12.1	128.2	12.1	130.4	12
221.6	12	223.8	12.2	234.7	12.2	236.8	12.3	239	12.9
241.2	13	243.3	13.2	245.5	14.2	247.7	14.8	249.9	14.3
252	14.4	254.2	13.1	256.4	12.8	258.6	11.8	260.7	10.7
262.9	9.7	269.4	9.7	271.6	10.3	273.8	10.5	275.9	10.8
278.1	11.3	280.3	11.7	282.5	12	291.2	12	293.3	12.3
295.5	12.7	297.7	13.5	299.8	13.8	302	14.4	304.2	15.5
307.8	15.6	309.9	15.5	312	15.3	314	14.7	318.2	13.9
320.3	12.9	322.4	12.6	324.5	12.4	328.7	12.2	332.9	12.2
335	12	337.1	12.2	343.4	12.2	345.5	12.1	349.6	12.1
351.7	12	366.4	12	368.5	11.7	370.6	11.7	372.7	12
379	12	381	12.4	383.1	12.6	387.3	12.6	389.4	11.6
391.5	11.5	393.6	11.3	395.7	11.2	397.8	11.3	399.9	11.2
402	11.2	406.2	11	460.6	11	462.7	11.2	466.9	11.4
469	11.4	471.1	11.3	473.2	11.7	475.3	12.5	477.4	12.2
479.5	12.2	481.5	12	485.7	12.4	487.8	13	489.9	13.1
492	12.3	494.1	12.6	496.2	13	498.3	12.9	500.4	13
502.5	13.9	505.2	13.2	507.5	13.9	509.7	13.9	512	14.1
516.4	13.7	518.7	12.1	520.9	12	523.2	11.3	525.4	11.2
527.7	11	529.9	11	532.2	11.3	534.4	11.7	536.6	11.7
538.9	12	563.6	12	565.8	12.8	568.1	11.9	570.3	11.6
572.6	11.1	574.8	11.5	577.1	12.2	579.3	13	581.6	12.4
583.8	11.5	586	11	588.3	11.9	590.5	12	592.8	12.1
595	12.7	597.3	12	599.5	12.1	601.8	11.6	604	11.2
606.3	11.5	608.5	12	610.7	11.5	613	11	615.2	11.7
617.5	12.2	619.7	12	649	12	651	12.4	653	13.3
655	13.6	657.1	13.5	659.1	13.3	663.1	13.8	665.1	13.3
667.1	13.1	669.2	12.9	671.2	12.5	673.2	12	677.2	12.3
679.2	13	681.3	12.9	683.3	12.3	687.3	12.9	691.4	12.5

693.4	12.2	695.4	12.7	697.4	13.7	699.4	14	703.5	14.4
705.5	14.9	707.5	15.1	711.5	15.2	715.6	15.2	717.6	15.6
719.6	16.3	721.6	16.6	723.6	18	727.7	19	733.7	19
735.7	18.9	737.8	18.9	739.8	18.3	743.8	18	747.8	18.6
749.9	18.6	753.9	19	755.9	18.6	759.9	19	766	19
768	18.5	770	18.7	772.1	17.8	774.1	17.5	776.1	16.4
778.1	16.3	782.1	16.1	784.2	16.5	786.2	17.3	792.2	17.6
794.2	17.5	796.3	17.2	798.3	17	800.3	17.4	802.3	17.2
806.3	17	810.4	17	812.4	16.4	814.4	16	816.4	16.6
818.5	16.4	820.5	16.1	824.5	16.3	826.5	16.8	828.5	17
830.6	15.5	832.6	14.6	834.6	14.4	836.6	13.6	838.6	13.3
840.6	13.2	842.7	13	844.7	12.9	846.7	12.6	848.7	13
852.8	13	854.8	13.3	858.8	13.3	860.8	14.9	864.9	14.1
866.9	13.6	868.9	12.7	870.9	12.1	873.3	11.4	877.5	11
904.5	11	906.6	11.1	908.7	11.3	910.8	11	914.9	11.4
917	12	919.1	12	921.2	11.8	923.2	11.4	925.3	10.4
927.4	10.3	929.5	10.1	931.6	10	935.7	10.1	937.8	10.3
939.9	10.2	942	10.4	944.1	10.4	946.1	10.2	948.2	10.6
950.3	11.1	952.4	11.7	954.5	12	964.9	12	966.9	12.1
969	12.6	971.1	13	973.2	13	975.3	13.2	977.3	13.9
979.4	14	981.5	14.4	983.6	15	985.7	15	987.7	15.6
989.8	15.7	991.9	16.3	994	16.4	996.1	16.7	998.2	16.6
1000.2	15.7	1004.4	15.7	1006.5	15.3	1008.6	15.7	1012.7	15.2
1014.8	16	1019	15.8	1025.2	14.6	1027.3	14.7	1029.4	14.6
1033.5	15	1035.6	14.8	1037.7	14.7	1039.8	14.7	1041.8	15
1050.2	15	1052.3	14.8	1054.3	14.7	1056.4	14.7	1058.5	14.5
1060.6	14.7	1062.7	14.6	1068.9	15	1071	14.7	1073.1	14.8
1075.1	14.7	1079.3	14.5	1083.5	14.5	1085.5	14.1	1087.6	14.2
1089.7	13.8	1091.8	13.2	1093.9	13	1095.9	12.4	1098	12.3
1100.1	11.7	1102.2	12	1104.3	12	1106.4	12.1	1108.4	12.4
1110.5	12.4	1112.6	11.7	1114.7	11.3	1116.8	12.3	1118.8	12.7
1120.9	12.8	1125.1	13.4	1127.2	13.8	1129.2	14.8	1131.3	15
1133.4	15	1135.5	14.6	1137.6	14.6	1139.6	14.4	1143.8	13
1148	13	1150	13.4	1152.1	13.9	1154.2	14	1156.3	13.1
1158.4	12.8	1160.5	12.7	1162.5	12.9	1164.6	12.8	1166.7	12.9
1168.8	12.6								

Manning's n Values num= 3
 Sta n Val Sta n Val
 0 .06 258.6 .06 278.1 .06

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.
 258.6 278.1 162 162 162 .1 .3
 Ineffective Flow num= 2
 Sta L Sta R Elev Permanent
 0 241.06 15.39 F
 307.67 1168.8 15.63 F

CROSS SECTION

RIVER: High
 REACH: Viaduct RS: 0

INPUT

Description:

Station Elevation Data		num= 212							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	41.4	2.1	39.7	4.2	38.8	6.3	37.4	8.4	35.3
10.5	33.5	12.6	33.1	14.7	31.5	16.9	29.7	19	27.9
21.1	27.5	23.2	25.3	25.3	24.5	27.4	23.2	29.5	21.7
31.6	21	33.7	20.1	35.8	18.9	37.9	18	40	17.5
42.1	16	44.2	15	46.4	14.5	48.5	14	50.6	13.3
52.7	12.9	54.8	12.7	56.9	12.7	59	12.6	61.1	12.6
63.2	12.2	65.3	12	200.1	12	202.3	11.9	210.7	11.9
212.8	11.8	217	11.8	219.1	11.7	225.4	11.7	229.6	11.5
236	11.5	238.1	11.4	240.2	11.4	242.3	11.3	254.9	11.3
257	11.2	259.1	11.3	261.2	11.5	263.4	11.7	267.6	12.1
271.8	12.1	278.1	12.4	284.4	12.4	286.5	12.6	288.6	12.6
290.7	12.3	292.8	11.8	295	11.5	297.1	11.4	299.2	11.4
301.3	11	335	11	337.1	11.3	339.2	11.8	341.3	12.1
343.4	12.2	345.5	12.1	347.6	12.2	349.7	12.2	351.8	12.4
353.9	12.4	356.1	12.7	358.2	12.9	360.3	14.9	362.4	15.4
364.5	16.2	366.6	15.8	368.7	13.8	370.8	12.9	372.9	12.6

375	12.6	377.1	12.4	381.3	12.4	383.4	12.1	385.5	11.4
387.7	11.3	389.8	11	406.6	11	408.7	11.1	410.8	11
412.9	11.4	415	11.5	417.2	11.4	419.3	11.7	421.4	12.2
423.5	12.4	425.6	12.3	427.7	12.6	429.8	12.7	430.6	13.7
432.7	15.1	434.8	15.8	436.9	16.6	439	17	441.1	16.5
443.2	15.7	447.4	13.9	449.5	13.5	451.6	13.2	453.7	13
472.7	13	481.1	12.2	483.2	12.2	485.3	12.1	489.5	12.1
491.6	12	535.7	12	537.8	12.2	539.9	12.3	542.1	12.6
544.2	12.8	548.4	13	558.9	13	561	12.8	563.1	12.4
567.3	12.2	569.4	12	603	12	605.1	11.4	607.2	11.2
611.4	11.2	613.5	10.9	615.6	11.2	617.7	11.2	619.9	11.4
622	11.8	624.1	11.8	628.3	12	664	12	666.1	12.2
668.2	12.5	670.3	12.7	672.4	12.6	674.5	12.9	676.6	12.9
678.7	12.7	682.9	12.7	685	12.1	687.1	12	693.4	12
695.5	12.1	697.7	12.3	706.1	12.7	708.2	12.9	710.3	13
1107.7	13	1109.8	13.3	1111.9	13.8	1114	14	1160.2	14
1162.3	14.3	1164.5	14.4	1166.6	14.5	1168.7	14.5	1170.8	15
1179.2	15	1181.3	14.9	1183.4	14.7	1185.5	14.6	1187.6	13.8
1189.7	13.8	1191.8	13.6	1193.9	13.1	1196	12.4	1200.2	12
1208.6	12	1210.7	12.2	1212.8	12.6	1214.9	12.8	1219.1	13
1244.4	13	1246.5	13.2	1248.6	13.7	1250.7	13.9	1252.8	13.9
1254.9	14	1315.8	14	1317.9	14.2	1320.1	14.3	1322.2	14.4
1326.4	14.4	1328.5	14.9	1330.6	15.1	1341.1	15.1	1343.2	15.3
1345.3	15.3	1347.4	15.4	1351.6	15.4	1353.7	15.7	1355.8	15.6
1357.9	15.2	1360	14.6	1362.1	13.8	1364.2	13.6	1366.3	12.5
1368.4	11.6	1370.5	11.5	1372.6	11	1376.8	11.2	1378.9	11.1
1381	11.2	1383.1	11						

Manning's n Values	num=	3
Sta n Val	Sta n Val	Sta n Val
0 .06	387.7 .06	412.9 .06

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
387.7	412.9	0	0	0	.1	.3	
Ineffective Flow	num=	2					
Sta L	Sta R	Elev	Permanent				
0	362.64	17.18	F				
441.59	1383.1	17.83	F				

SUMMARY OF MANNING'S N VALUES

River: High

Reach	River Sta.	n1	n2	n3
Viaduct	1054	.06	.06	.06
Viaduct	930	.06	.06	.06
Viaduct	816	Bridge		
Viaduct	702	.06	.06	.06
Viaduct	485	.06	.06	.06
Viaduct	162	.06	.06	.06
Viaduct	0	.06	.06	.06

SUMMARY OF REACH LENGTHS

River: High

Reach	River Sta.	Left	Channel	Right
Viaduct	1054	124	124	124
Viaduct	930	228	228	228
Viaduct	816	Bridge		
Viaduct	702	216.91	216.91	216.91
Viaduct	485	322.38	322.38	322.38
Viaduct	162	162	162	162
Viaduct	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
 River: High

Reach	River Sta.	Contr.	Expan.
Viaduct	1054	.1	.3
Viaduct	930	.1	.3
Viaduct	816	Bridge	
Viaduct	702	.1	.3
Viaduct	485	.1	.3
Viaduct	162	.1	.3
Viaduct	0	.1	.3

Profile Output Table - Standard Table 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G.
Slope	Vel Chnl	Flow Area	Top Width	Froude #	Chl			
(ft/ft)	(ft/s)	(sq ft)	(ft)	(cfs)	(ft)	(ft)	(ft)	(ft)
Viaduct	0	50-year	464.00	11.00	14.90	13.00	14.99	
0.002004	2.72	197.09	1277.08	0.24				
Viaduct	0	100-year	530.00	11.00	15.17	13.12	15.27	
0.002001	2.85	215.04	1305.79	0.25				
Viaduct	0	500-year	685.00	11.00	15.77	13.39	15.89	
0.002003	3.12	255.02	1328.93	0.25				
Viaduct	162	50-year	464.00	9.70	15.20	12.91	15.31	
0.001896	3.05	189.59	985.10	0.24				
Viaduct	162	100-year	530.00	9.70	15.34	13.10	15.47	
0.002168	3.32	198.54	994.77	0.26				
Viaduct	162	500-year	685.00	9.70	15.91	13.48	15.91	
0.000013	0.28	3377.75	1027.71	0.02				
Viaduct	485	50-year	464.00	12.40	15.79	14.32	15.91	
0.003368	3.17	167.04	309.84	0.31				
Viaduct	485	100-year	530.00	12.40	15.90	14.42	15.95	
0.001638	2.26	315.65	320.86	0.22				
Viaduct	485	500-year	685.00	12.40	15.86	14.71	15.95	
0.002882	2.98	310.43	317.49	0.29				
Viaduct	702	50-year	464.00	26.30	28.68	28.68	29.36	
0.048194	6.62	70.09	51.58	1.00				
Viaduct	702	100-year	530.00	26.30	28.81	28.81	29.54	
0.046894	6.86	77.25	52.77	1.00				
Viaduct	702	500-year	685.00	26.30	29.16	29.16	29.94	
0.045965	7.08	96.73	62.07	1.00				
Viaduct	816	Bridge						
Viaduct	930	50-year	464.00	42.30	44.27	43.71	44.34	
0.010003	2.20	210.82	251.02	0.42				
Viaduct	930	100-year	530.00	42.30	44.35	43.77	44.43	
0.010008	2.27	233.13	264.46	0.43				
Viaduct	930	500-year	685.00	42.30	44.51	43.95	44.61	
0.010055	2.47	277.15	278.24	0.44				
Viaduct	1054	50-year	464.00	49.70	51.59	51.59	52.05	
0.054869	5.45	85.16	93.21	1.00				
Viaduct	1054	100-year	530.00	49.70	51.67	51.67	52.18	
0.055675	5.68	93.29	96.95	1.02				
Viaduct	1054	500-year	685.00	49.70	51.87	51.87	52.45	

0.050703

6.08

112.75

98.74

1.00

Pier Scour

All piers have the same scour depth

Input Data

Pier Shape:	Round nose
Pier Width (ft):	6.50
Grain Size D50 (mm):	0.15000
Depth Upstream (ft):	1.73
Velocity Upstream (ft/s):	3.03
K1 Nose Shape:	1.00
Pier Angle:	0.00
Pier Length (ft):	200.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	0.20000
K4 Armouring Coef:	1.00

Results

Scour Depth Ys (ft):	6.11
Froude #:	0.41
Equation:	CSU equation

Appendix C: Structure Plans

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No	TOTAL SHEETS
04	SF	1,101			

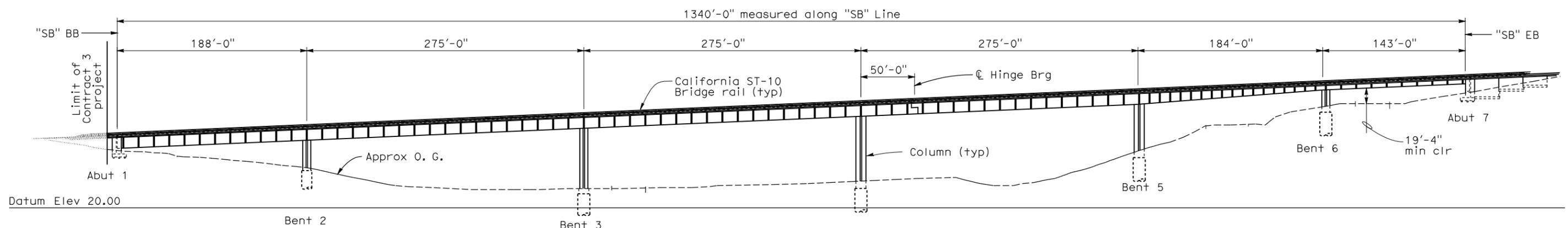
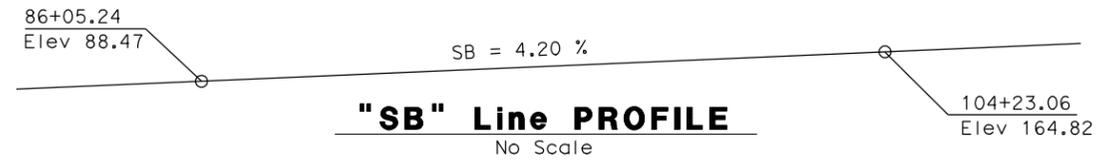
REGISTERED CIVIL ENGINEER X DATE _____

PLANS APPROVAL DATE _____

REGISTERED PROFESSIONAL ENGINEER
 AHMED M.W. IBRAHIM
 No. S 4865
 Exp. 9-30-10
 STRUCTURAL
 STATE OF CALIFORNIA

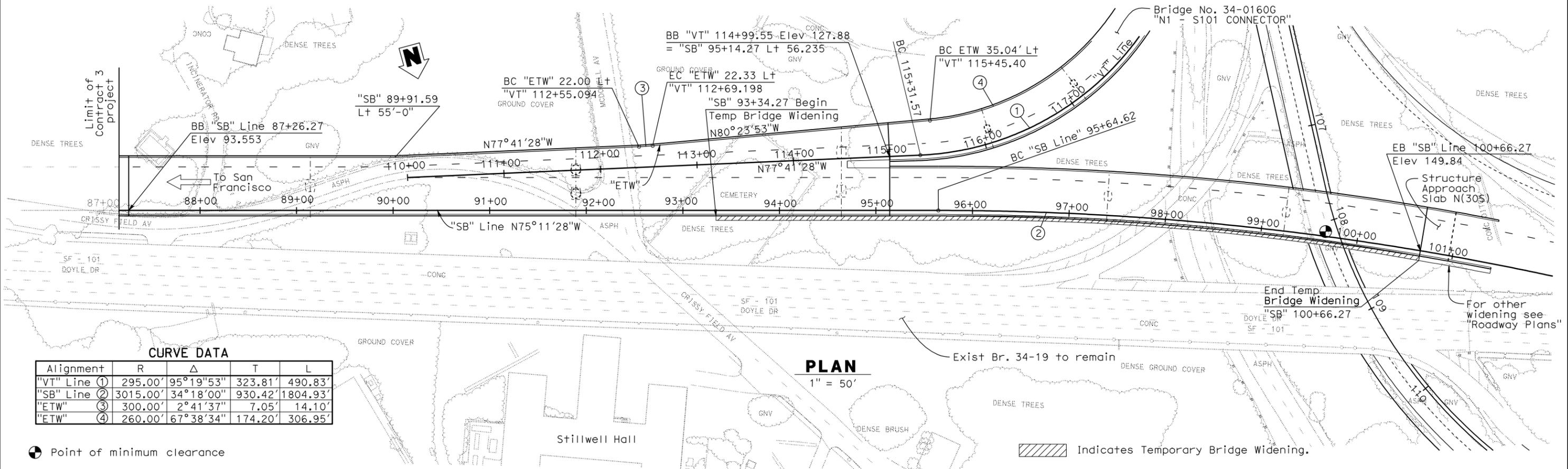
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ELEVATION
1" = 50'

NOTE: For Typical Sections, see "GENERAL PLAN NO. 2" sheet.



CURVE DATA

Alignment	R	Δ	T	L
"VT" Line ①	295.00'	95°19'53"	323.81'	490.83'
"SB" Line ②	3015.00'	34°18'00"	930.42'	1804.93'
"ETW" ③	300.00'	2°41'37"	7.05'	14.10'
"ETW" ④	260.00'	67°38'34"	174.20'	306.95'

Point of minimum clearance

PLAN
1" = 50'

X DESIGN ENGINEER	DESIGN BY X	CHECKED X	LOAD & RESISTANCE FACTOR DESIGN	LIVE LOADING: HL93 W/"LOW-BOY"; PERMIT DESIGN VEHICLE	STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION	DIVISION OF ENGINEERING SERVICES STRUCTURE DESIGN DESIGN BRANCH 4	BRIDGE NO. 34-0157L	PRESIDIO VIADUCT - LEFT GENERAL PLAN NO. 1
	DETAILS BY JFCasario	CHECKED X	LAYOUT BY X	CHECKED X			POST MILE 9.02	
	QUANTITIES BY X	CHECKED X	SPECIFICATIONS BY Jim Corrado	PLANS AND SPECS COMPARED X			REVISION DATES	SHEET 1 OF X

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) (REV. 10/25/05)

ORIGINAL SCALE IN INCHES FOR REDUCED PLANS

CU 04247
EA 163731

DISREGARD PRINTS BEARING EARLIER REVISION DATES

1-7-09 1-27-09 2-20-09 2-20-09 3-3-09 5-3-09 5-12-09

FILE => 34-01571_ga-gp01.dgn

STRUCTURES DESIGN GENERAL PLAN SHEET (ENGLISH) (REV.07-24-06)